**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, D.C. 20554**

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| In the Matter of | ) | |
| | ) | |
| Price Cap Performance Review | ) | CC Docket No. 94-1 |
| For Local Exchange Carriers | ) | |
| | ) | |
| Access Charge Reform | ) | CC Docket No. 96-262 |

# GTE REPLY COMMENTS


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affiliated local exchange carriers,

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January 24, 2000

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## SUMMARY

The Commission should adopt the CALLS proposal. By establishing a reasonable path for interstate access prices for the next five years, CALLS would provide benefits for access customers, for ILECs, and for consumers. The resolution of price cap and universal service issues through adoption of CALLs would obviate the need to choose and justify an X-Factor in the context of the FNPRM.

Failing that, if the Commission must adopt an approach to productivity offsets outside of the CALLS framework, then it should employ the model it adopted in 1997 for the measurement of TFP. A statistically valid and accurate forecasting method, called an ARIMA model, should be used each year to project the percentage adjustment to the price cap index for the following year. GTE presents here a demonstration by Dr. Gregory Duncan of how such a forecasting model should be used, based on the estimates from the 1997 TFP model and the changes in GDPPI for the historical period for which the Commission has data.

The statistical forecasting model proposed by GTE would eliminate subjective and results-oriented choices by the Commission from the determination of the productivity adjustment. Because the process would be repeated each year, any changes in productivity would be automatically incorporated, and the resulting process would closely mimic the operation of a competitive market, both in the efficiency incentives provided to firms and in the price benefits provided to consumers.

The Commission should not adopt the invalid and biased alternative models discussed in the FNPRM. In particular, it should not accept AT&T's claim that its 1999 model can be applied on an interstate basis; AT&T's assertion is based on the false

assumption that productivity can be measured for interstate services alone. The "imputed X" model should not be adopted either, because it represents a reversion to rate-off-return regulation, and because it too assumes incorrectly that price cap results can be measured separately for interstate services.

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# GTE REPLY COMMENTS

GTE Service Corporation and its affiliated local exchange carriers[1] (collectively "GTE") hereby submit their Reply to the comments submitted in response to the Further Notice of Proposed Rulemaking ("FNPRM") in the above-captioned proceeding. In the FNPRM, the Commission sought comment on the appropriate method for determining the price cap productivity offset, or X-Factor. The method adopted by the Commission in 1997 has been vacated and remanded to the Commission by the U.S. Court of Appeals.[2]

## I. THE COMMISSION SHOULD ADOPT THE CALLS PROPOSAL.

GTE is a member of the CALLS coalition, which has jointly submitted to the Commission an integrated proposal for reform of price caps, universal service and other

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[1] GTE Alaska, Incorporated, GTE Arkansas Incorporated, GTE California Incorporated, GTE Florida Incorporated, GTE Hawaiian Telephone Company Incorporated, The Micronesian Telecommunications Corporation, GTE Midwest Incorporated, GTE North Incorporated, GTE Northwest Incorporated, GTE South Incorporated, GTE Southwest Incorporated, Contel of Minnesota, Inc., GTE West Coast Incorporated, and Contel of the South, Inc.

[2] *USTA v. FCC*, 188 F.3rd 521 (D.C. Cir. 1999).

matters.[3] GTE agrees with AT&T that the Commission "should adopt the CALLS plan to rationalize the access and universal service regimes."[4] As AT&T correctly notes, "the CALLs plan would resolve, in an equitable and sustainable manner, virtually all of the issues raised in the Further Notice." Rather than continue the contentious decades-long price cap plan debates, the Commission should adopt the CALLs proposal, which would establish a reasonable and predictable path for access prices over the next five years.

## II. IF THE COMMISSION MUST ESTABLISH A PRODUCTIVITY ADJUSTMENT FOR PRICE CAPS, IT SHOULD APPLY WELL-ACCEPTED STATISTICAL METHODS TO THE RESULTS OF ITS 1997 MODEL.

If the Commission does not adopt the CALLs proposal, then it should determine productivity adjustments in its price cap plan using the method set forth in GTE's Comments.[5] The Commission should rely on the model for estimating Total Factor Productivity ("TFP") it adopted in 1997 ("1997 Model"). Although some commenters have provided additional years of data that have since become available, no one has demonstrated that the 1997 Model should be changed. Significantly, the Court of Appeals did not find fault with the 1997 Model, nor did it require the Commission to re-examine it.

For the period since 1997, the Commission should begin with the TFP estimates produced by the 1997 model, using the data available at the time of the 1997 Order.[6] It should estimate the year-over-year adjustment to the price cap index for each basket

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3 The other members of the CALLS coalition are AT&T, Sprint, SBC, Bell Atlantic and BellSouth.

4 AT&T at 2.

5 GTE at 4-11.

(the "PCI adjustment factor") based on the estimated TFP, the estimate of nationwide TFP provided by the Bureau of Labor Statistics ("BLS") and the nationwide index of prices ("GDPPI") also from the BLS. These data should be used to construct the value of the PCI adjustment ("GDPPI-X") for each year of the historical series. A standard time-series statistical method, called an ARIMA model, should then be used to forecast the next year's value for the PCI adjustment. This should be done on a rolling basis each year, using all available years of data.[7] No consumer productivity dividend ("CPD") should be added to the results of this statistical estimation. In the annual filing to be made July 1, 2000, price cap local exchange companies ("LECs") should be allowed to adjust their price cap indices to compensate for the difference between the PCI adjustments derived in this fashion for the period 1997-2000 and the PCI adjustments that were actually made during that period, pursuant to the Commission's 1997 Order.

For prospective price cap adjustments, the Commission should continue each year to add data for one additional year to its historical series, and then to apply the ARIMA forecasting method to the series to produce the most accurate and statistically valid estimate of the PCI adjustment factor for the next year.

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6 *Price Cap Performance Review for Local Exchange Carriers*, Fourth Report and Order in CC Docket No.94-1 and Second Report and Order in CC Docket No.96-262, 12 FCC Rcd 16642 (1997)("1997 Order").

7 *E.g.*, the Commission would use the data available in 1997 to estimate the PCI adjustment factor that would have been used in the 1997 annual filing. One year's worth of additional data would then be added to the series, and the PCI adjustment for the 1998 annual filing would be estimated, and so on.

### A. The Proposed Statistical Method Can Readily be Applied to Achieve an Accurate Forecast of the PCI Adjustment.

In Attachment 1 to these Reply Comments, Dr. Gregory Duncan explains the specific operation of this time series forecasting method for estimating the PCI adjustment factor. As Dr. Duncan points out, basing the next year's PCI adjustment on a statistically valid forecast of price changes is the most accurate way for price caps to mimic the operation of a competitive market.

Dr. Duncan shows that the Autoregressive Integrated Moving Average ("ARIMA") time series method is the correct statistical approach for estimating the productivity adjustment, given the historical data available to the Commission. The ARIMA approach eliminates the possibility of subjective, results-oriented decision-making because it evaluates the data on a purely objective statistical basis.

A series of well-defined steps are used to analyze the data, to identify the statistical patterns in the data and to specify the correct model to be used for forecasting. The statistical "rules" governing each step in this process are well known and accepted by statisticians. Further, through this objective process, the ARIMA method will answer the questions raised in the FNPRM concerning the proper use of the data, such as whether a trend exists, or what weight to assign to different years in the series. The ARIMA framework contains components for time trends and cyclical patterns, and the model includes any of these elements that are found to be statistically important. As Dr. Duncan shows, the statistical method proposed by GTE can be applied using a standard, widely available statistical package, and would require only about one hour to complete.

Dr. Duncan applies the proposed statistical method to the actual TFP results produced by the 1997 model, as updated by USTA for the additional years of data which have become available since 1997. He finds, on the basis of objective statistical tests, that there is no trend in the data. Similarly, the ARIMA process does not find any autoregressive or moving average structure in the data.[8]

The best estimate is therefore given by the simple mean for the entire sample. However, it should be noted that this result is not a general one; it holds only for the particular years of data (1986-1998). If the data are updated each year as GTE proposes, and the ARIMA model is used to predict the next year's PCI adjustment, then the specification of the ARIMA model may change over time. Indeed, one of the strengths of the ARIMA framework is that it is not limited to a rigid structure, but instead is optimized each time it is used, so that the structure used is the one that best fits the data.

The ARIMA method can be used to forecast the X-Factor alone, based on a historical series of estimated X-Factors from the 1997 model. Dr. Duncan finds that, used in this manner, the ARIMA process predicts an X-Factor of 4.62 percent for next year. However, as GTE explained in its Comments, more reliable results can be

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[8] The Court questioned the basis for the Commission's assertion, in its 1997 Order, that a trend existed in the data. The Court asked whether there was instead a cyclical pattern. In fact, as Dr. Duncan's analysis shows, there is neither a trend nor a cyclical pattern. This illustrates the danger of attempting to discern patterns in data which contain a high degree of random variation, and demonstrates the importance of using valid statistical techniques, rather than guesswork, to set price cap parameters. For example, Ad Hoc offers vague arguments (at 13) to justify according greater weight to more recent years in the sample, based on Ad Hoc's assumption that "accelerating pace of technological change" is leading to increasing rates of TFP growth. The choice of how much weight to accord each year should be an objective one, and, in any event, the data do not support Ad Hoc's presumption that TFP growth is increasing over time.

obtained by assembling a historical series for the PCI adjustment itself (GDPPI – X) and applying the statistical forecasting method to predict next year's PCI adjustment. When Dr. Duncan performs this analysis, he finds the predicted value of next year's PCI adjustment to be –2.09 percent.

As GTE noted in its Comments, its proposal is generally consistent with the method proposed by USTA, which would use a five-year moving average to estimate the X-Factor on a rolling basis each year. As Dr. Duncan notes, for the particular data available at this time, a five-year moving average performs about as well as the ARIMA model does, based on a comparison of the sum of squared deviations for each method. The estimate of the PCI adjustment for next year produced by the ARIMA model is slightly lower than that generated by a five-year moving average, while the estimate of the X-Factor is slightly higher. However, GTE recommends that the Commission should adopt the ARIMA method, because it will produce more reliable estimates over time. As Dr. Duncan explains, the five-year moving average suggested by USTA, may perform well given the current data, but may not adapt well if the pattern of the data should change over the next few years. In contrast, the ARIMA framework will change the specification of the time series model each year as needed to fit the data, and will thus produce more accurate forecasts for a wide range of possible data.

### B. The Proposed Forecasting Method Will Provide the Same Incentives and Prices as a Competitive Market.

As GTE explained in its Comments, the proposed forecasting method will effectively mimic the operation of a competitive market. Dr. Duncan notes that such a market behaves as if participants were basing their decisions on the best available forecasts of the next year's prices – which is precisely what the ARIMA method

provides. Because it operates on efficient, accurate forecasts, the proposed method would cause the prices of price cap LECs to track changes in their costs from year to year. Because it would mimic the actions of a competitive market, this process would provide the same mix of incentives for firms to operate efficiently and price benefits for consumers that a competitive market would provide. In the short run, a firm that reduced its costs would earn transitory profits as a return to its innovation. Over time, as the industry as a whole adopted these efficient methods, the forecasting approach would incorporate this effect into the predicted PCI adjustment, thus passing on the benefits of improved efficiency to consumers.

## III. NO CONSUMER PRODUCTIVITY DIVIDEND IS WARRANTED.

The Commission has included a Consumer productivity dividend of one half of one percent in its determination of the X-Factor since the beginning of its price cap plan. The Commission has justified this CPD on the basis of its expectation that a change in regulation would lead to a change in productivity on a prospective basis, and that a CPD is necessary to capture this productivity gain for consumers. Initially, this one-time change was for the adoption of incentive regulation. In the 1997 Order, it was for the elimination of sharing. The Court, in remanding the 1997 Order, found that the Commission had not adequately justified its inclusion of a CPD in 1997.

In fact, there is no evidence for any increase in productivity that is unaccounted for in the 1997 model. As Dr. Taylor points out for USTA, the elimination of sharing began in the early 90s, and was completed in 1997. There has thus been ample time for any resulting change to appear in the data. This is no longer a matter for mere speculation, but rather one of statistical fact. The fact, as documented by Dr. Duncan, is that there is no trend identifiable in the data for the years 1986-1998. There is,

therefore, no rational basis for the including a CPD; to do so is an arbitrary upward adjustment beyond what would otherwise be justified by the record.

AT&T tries to show that the CPD is justified on the basis of a study by Strategic Policy Research ("SPR").[9] The study was designed to measure ILEC incentives, by calculating the change in the proportion of any additional dollar of cost saving an ILEC would be allowed to retain under different forms of regulation. Without any basis, AT&T equates a change in this number to a change in productivity. As Dr. Taylor shows, a percentage change in the number estimated by SPR does not correspond to any particular change in productivity.[10] AT&T claims to be able to "further refine" this "analysis," and to distinguish the portion of this fictitious "effect" that can be attributable to the adoption of price cap regulation, rather than to the elimination of sharing. All of this is quite remarkable, given that there is no trend in the data. Simply put, AT&T is manufacturing something out of nothing.

In any event, there is no need for a CPD to capture either past or future changes in productivity, whatever their cause. If the Commission estimates each year's PCI adjustment in the manner GTE has proposed, the effects of any increase in productivity will be incorporated automatically into the price cap formula over time, just as a competitive market would adjust prices to reflect changes in productivity. Any additional

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9 AT&T at 20-21.

10 This is not to say that price cap incentives are not enhanced by the elimination of sharing, or that the Commission made a mistake when it eliminated sharing. As Dr. Taylor points out, the realized productivity change in any given period depends on many factors. Eliminating sharing may have improved incentives, but the net result of all factors has been that the expectation of productivity improvement today is the same as it was in earlier years in the sample.

adjustment through a CPD, even if based on actual productivity changes, would double-count those changes.

## IV. THE COMMISSION SHOULD NOT ADOPT EITHER OF THE ALTERNATIVE MODELS DISCUSSED IN THE FNPRM.

If the Commission were to consider any change from its 1997 model for estimating TFP (other than updating for more recent data), it should consider the TFPRP model developed by USTA. As GTE noted in its Comments, the TFPRP model follows generally accepted practice for estimating TFP more closely than does the 1997 model. In its Reply Comments, USTA provides estimates from its TFPRP model, updated to reflect the data newly available since 1997. For 1998, the TFPRP produces an estimate of X which is slightly higher than that produced by the 1997 model (3.79 percent vs. 3.03 percent); while for the most recent five years the average X estimated by the TFPRP is slightly lower (3.71 percent vs. 4.06 percent.) The fact that both models produce comparable estimates tends to confirm the reasonableness of both sets of estimates.

### A. The 1999 Staff Model Does Not Produce Reasonable Estimates Of TFP.

The FNPRM suggests an alternative model, based on the 1997 model, but modified by the staff (the "1999 model"). As Dr. Gollop showed in his attachment to USTA's Comments, almost every variable in the 1997 study has been changed, and every change results in a higher estimate of X.

The 1997 model was based on the assumption that revenues are equal to cost. This allowed the staff to estimate the cost of capital as a residual, after other inputs had been accounted for. In this respect, the 1999 study differs from standard practice for measurement of TFP, in which an external measure of the cost of capital would be

used. The 1999 study purports to correct this "flaw" in the 1997 study, by using changes in a series of Baa bond yields supplied by Moody's. This change to the model is not reasonable.

First, while the residual measure of the cost of capital in the 1997 model departs from common practice, it does not follow that it creates any error that must be corrected. In fact, as USTA has amply demonstrated, ILEC returns to capital have been reasonable throughout the price cap period. Earnings of price cap LECs have grown much more slowly than those of firms in the economy generally since price caps were adopted. Thus, if ILEC earnings were reasonable at the beginning of price caps, as the 1999 model assumes, they are also reasonable now. Attachment 1 to USTA's Comments shows that profit margins of the price cap LECs have remained at or slightly below their levels under rate of return. As GTE explained in its Comments in the access reform proceeding, the reported interstate earnings of the price cap LECs have been artificially inflated by the allocation process in separations, by the effect of the growth in Internet minutes on that allocation and by the unrealistic depreciation rates the Commission has required for regulatory purposes. When more relevant economic measures of earnings are examined, there is no "excess" to be accounted for, and thus the residual method for determining the cost of capital used in the 1997 model, which takes the actual economic returns of the ILECs as the cost of capital, has not introduced any error into the measurement of TFP. This is further confirmed by the fact that the USTA TFPRP model, which uses an external measure of the cost of capital, produces estimates close to those from the 1997 model.

Ad Hoc supports the use of the Moody bond series, and purports to show its reasonableness through a "sensitivity" study, which shows that other bond yield series would produce similar results.[11] This misses the point that bond yields – whether Baa or some other kind – are not good proxies for the opportunity cost of capital to a firm whose best alternative use for funds is another equity investment, not a bond fund. MCI suggests that "all capital costs move in a synchronized manner" so that the choice of any particular measure of capital costs should not bias the outcome of the study.[12] This is simply not correct. As Professor Gollop has shown, bond yields have dropped since the adoption of price caps, while returns to equity have increased. The arbitrary choice of a series of bond yields as a measure of the change in the cost of capital during the period, therefore, causes a bias in a quite predictable direction -- it causes the model to overestimate productivity gains.

If the Commission is truly concerned about the lack of an external measure of the cost of capital in the 1997 model, it should adopt the TFPRP model, which employs an economically meaningful external measure of the cost of capital. Otherwise, the Commission should continue to rely on the 1997 model, since there is no evidence that the method used has caused any bias in the estimates. It certainly should not adopt the incorrect measure used in the 1999 model.

### B. The Commission Should Not Adopt Minutes of Use AS Its Measure of Local Output.

The 1999 model further departs from the 1997 model by using Dial Equipment Minutes ("DEMs") as its measure of local output. The USTA TFPRP study uses the

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11 Ad Hoc at 7.

12 MCI at 8.

widely accepted deflated revenue approach,[13] a superior method for measuring output. This approach is widely used precisely because it includes all the firm's outputs, weighted by their prices, and thus obviates the need to make an arbitrary choice of just one item to represent a broad category of the firm's outputs. Nonetheless, some parties suggest that the change from messages to minutes of use as the measure of local output would improve the accuracy of the TFP estimate by capturing the effect of longer average holding times.[14] If only one output must be chosen, and if the Commission wishes to modify the 1997 model, local lines would be a more reasonable choice than minutes. Loop costs, not switching, account for the greatest portion of local service costs. Further, most local revenue is related to lines.[15] Over the period 1986-1998, the correlation between the growth in lines to the growth in revenue has been about .75 -- twice as great as the correlation between minute growth and revenue growth.[16] A measure based on lines would more closely correspond to the correct measure of deflated revenue, in which each output is weighted by its relative price.

### C. There Is No Basis For Considering "Hedonic" Adjustments to Input Prices.

Ad Hoc argues that the change in the quality of capital inputs is somehow lost in the Commission's measure of TFP, and thus should be measured separately though a form of "hedonic" measurement, the specifics of which Ad Hoc is unable to provide. In

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[13] GTE explained in its Comments, at 12, that deflated revenue is the widely accepted measure of output in a TFP study.

[14] *See, e.g.*, Ad Hoc at 9.

[15] Ad Hoc admits (at 9) that since most local service is flat-rated, "charges are not directly related to either the number of calls or the number of minutes."

[16] Further, the correlation with revenue growth is similar regardless of whether minute growth or message growth is used.

fact, a TFP model is based on physical quantities of inputs, and prices are used only as weights in developing indices of these inputs. "Hedonic" adjustments are sometimes used in the development of price indices, in order to insure that equivalent commodities are being priced in different time periods. In a TFP study, the effect of any qualitative improvement is seen directly in the measure of TFP, to the extent that the qualitative improvement allows a given quantity of inputs to produce a greater output. Finally, it should be noted that, if such an adjustment were (incorrectly) made, it would have the opposite of the effect Ad Hoc desires. A hedonic adjustment would increase the quantity of the input being qualitatively augmented, and would thus decrease the measured growth in TFP. Therefore, there is no place for "hedonic" adjustments to the inputs of a TFP study.[17]

**D. TFP Cannot Be Defined on an Interstate Basis.**

AT&T argues that it has solved the problem of measuring productivity growth on a jurisdictional basis, thus allowing the Commission to employ the 1999 model on the ILEC's interstate business only.[18] AT&T suggests that this more "correct" approach has been prevented until now only by difficulties in measurement, which have now been solved through a clever restatement of the derivation of the price cap formula.[19] According to AT&T, "this more direct measure permits the Commission to calculate the interstate-only X-factor without the analytical difficulties created by the question of how to segregate out interstate inputs."

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17 As Dr. Taylor points out, the Commission has already rejected the use of hedonic adjustments in the measurement of productivity.

18 AT&T at 9.

19 AT&T at Appendix A.

In fact, the "analytical difficulty" of determining TFP on an interstate basis is not merely a problem of measurement. TFP for interstate services is not defined; there is thus nothing to be measured. Because the production function of an ILEC is not separable between state and interstate services, there is no such thing as an interstate productivity factor. The algebraic gymnastics presented by Mr. Friedlander in Appendix A to AT&T's Comments do not change these fundamental facts. Mr. Friedlander begins with the premise of the 1997 study, which is that cost equals revenue.[20] This allows him, in the middle of his analysis, to assume that interstate inputs can be measured by using interstate revenues. At this point, Mr. Friedlander has implicitly, and incorrectly, assumed the separability of the production function. As Dr. Duncan makes clear in Attachment 1 to these Comments, "[a] TFP based price cap formula cannot be based on the equality of interstate revenues and allocated interstate costs unless the cost structure is separable between interstate and intrastate activities." The Commission has long recognized that the production of state and interstate services is not separable, because of the presence of significant joint, common and shared costs. Mr. Friedlander's "discovery" is thus merely that he can hide his incorrect assumption.

In any event, as Dr. Taylor demonstrated in his attachment to USTA's comments, it is not meaningful to think of a separate "interstate" TFP that is somehow resistant to measurement. It is more correct to say that both state and interstate production of ILEC services have the same growth in TFP. Thus it is simply wrong to claim, as MCI does, that the use of total company, rather than interstate, results introduces a "bias" in the

[20] Mr. Friedlander does not actually accept this premise. He adjusts for a presumed error in the cost of capital, based on the Moody's bond series, which is incorrect for the reasons discussed above.

estimate of productivity, because interstate services have grown more rapidly in the past.[21] As Dr. Taylor shows, even if one service grows faster than another, both have the same productivity growth if the production function is not separable. Most significantly, in a competitive market, the prices of both services would be affected in the same way by changes in productivity over time. The Commission's price cap plan correctly imposes a path of price changes over time on interstate services based on the total (state and interstate) productivity growth of the ILECs. To do otherwise would be to depart from the result a competitive market would produce.

**E. There is No Support in the Record for an Imputed X Model.**

The third alternative suggested in the FNPRM is an "imputed X" model, in which the staff seeks to derive the X factor that would have held ILEC earnings at a given level. There is virtually no support among the commenters for this approach – even among the IXCs who might presumely gain from the high X-Factor this model would produce. As Dr. Taylor correctly points out, the most fundamental problem with the "imputed X" model is that it replicates rate-of-return regulation under the guise of price caps. For this reason, the Commission has consistently rejected this method. Most recently, the Commission declined to adopt the Historical Revenue Approach proposed by AT&T, noting that it would create "substantially similar incentives to those under rate-of-return regulation, because the X-Factor would be explicitly linked to earnings."[22] Sprint observes that "the imputed X study is nothing more than a retitled version of the

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[21] MCI at 10. In any event, as GTE noted in its Comments, the growth of interstate services has slowed dramatically and it is no longer clear that interstate outputs are growing more rapidly than intrastate outputs.

[22] 1997 Order at ¶22.

previously rejected Historical Revenue Method."[23] Further, because the imputed X model is based on reported interstate earnings, it incorporates further mistakes. It implicitly tries to measure productivity on an interstate basis, which cannot be done for reasons discussed above. Further, to accomplish this, it incorporates all of the infirmities of embedded cost accounting and of the separations process. GTE agrees with Sprint that the imputed X model should be rejected "for the same reasons as its predecessor and more."

## V. CONCLUSION.

The Commission should adopt the CALLs proposal, which would obviate the need to decide the issues raised in the FNPRM. Failing that, the Commission should employ the same model it adopted in 1997 for the purpose of measuring TFP. The Commission should use a well-recognized statistical forecasting tool, the ARIMA time-series model, to predict the value of the next year's PCI adjustment factor, based on the historical values of X and of GDPPI. This approach would eliminate arbitrary and subjective elements from the Commission's choice of productivity parameters for price caps. It would allow the price cap mechanism to mimic the results of a competitive market by accurately predicting the price levels a competitive market would impose.

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[23] Sprint at 5.

January 24, 2000

Respectfully submitted,

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Their Attorneys

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**AFFIDAVIT OF**
**GREGORY M. DUNCAN**

I, Gregory M. Duncan, being duly sworn, say:

1. My name is Gregory M. Duncan. I am a Senior Vice President at National Economics Research Associates, Inc. ("NERA") where I am a member of the Board of Directors. NERA, which was established in 1961, is an international firm of consulting economists recognized for its work in antitrust matters, telecommunications, energy, securities litigation, employment and discrimination, intellectual property, environment, health, transportation, international trade and sports.

2. My educational background includes a Master's degree in Statistics (1974) and a Ph.D. in Economics (1976) both from the University of California, Berkeley. Beginning in 1975, I taught in the Economics Department and Statistics Program at Northwestern University in Evanston, Illinois, where I was an Assistant Professor of Economics and of Statistics. There, my teaching included demand, cost and production theory, econometrics, and statistics. I also conducted research on demand and cost and production that appeared in

refereed journals. I left Northwestern in 1979 to join the faculty at Washington State University where I served as Professor of Economics and of Statistics. I continued with my research in demand, production, cost theory, and applications, as well as in other topics. During that period, I was one of the first Associate Editors of the academic journal *Econometric Theory*. Before joining NERA, I was employed by GTE Laboratories, Inc.'s Department of Economics and Statistics where I was a Staff Scientist, a position reserved for a small number of independent researchers with responsibility for developing, proposing, and conducting research, as well as supervising the research of other economists and statisticians.

3. I have published many refereed papers in cost, production, and demand analysis, including the results of the research that supported other testimony before a number of regulatory commissions. My particular expertise includes the area referred to as applied microeconomics. Because of this, I have been asked to teach and have taught many graduate level courses that covered directly and indirectly all aspects of microeconomics. My papers in this area appear in the *International Economic Review, Proceedings of the National Academy of Sciences, Econometrica*, and the *Journal of Risk and Uncertainty*. Under my supervision, a number of Ph.D. students at Northwestern University, Washington State University, and Boston University wrote dissertations that used modern demand methods.

4. The purpose of this affidavit is to discuss optimal forecasting techniques that are available for use in determining the price cap adjustment factor. To

illustrate these techniques and also the ease with which some of the readily available software can be used that implement these techniques, GTE asked me to do a time series analysis. I performed this analysis on the results of the Total Factor Productivity ("TFP") study adopted by the Commission in 1997, as updated by Frank M. Gollop for the United States Telephone Association ("USTA").[24] The Gollop Study followed the Commission staff's method of calculating a productivity offset—a TFP-based method—and added two additional year's data to produce a more current result. The purpose of my analysis was to examine the efficacy of various forecasting methods for calculating the productivity offset commonly referred to as the X-Factor. The first conclusion that I was able to draw from my analysis is that the PCI adjustment factor for any given year, of which the X-Factor is one component, should be an optimal forecast of the PCI change that would occur in that year based on actual observed changes in the PCI in previous years. My second conclusion is that if the X-Factor is to be estimated independently from the growth in GDPPI then it too should be forecast using optimal methods. Additionally, GTE asked me to review the comments of Stephen Friedlander filed on behalf of AT&T in this proceeding. Specifically, I was asked to review and comment on Mr. Friedlander's claim that he has discovered a method to calculate a TFP-based, economically meaningful, interstate only X-Factor.

[24] *See* USTA Comments at p. 24 and Attachment 6. *See also* Comments of the United States Telephone Association in this proceeding, dated October 22, 1998, Attachment D. I will refer to the update of the Commission's Model as the "Gollop Study."

## INTRODUCTION

5. In May 1997, the Commission adopted a new productivity offset or X-Factor of 6.5 percent for use in the price cap formula by Local Exchange Carriers ("LECs") when they calculated the annual adjustment to the Price Cap Index ("PCI").[25] The Commission based the adopted productivity offset on a TFP estimation method developed by the Commission staff (the "1997 Model"),[26] which used the averages of several years of prior productivity to come up with an estimate of 6.0 percent.[27] The Commission then added a "consumer productivity dividend" to arrive at the X-Factor of 6.5 percent that has been in effect since 1997. Based on a court ordered remand,[28] the Commission has now reopened the issue of the best method for represcibing the X-Factor.[29] Previously, GTE recommended the use of a time series method to determine the next year's PCI adjustment factor. GTE continues to support a time series approach.[30] As discussed in this affidavit, the results of my analysis of the

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[25] *See* Price Cap Performance Review for Local Exchange Carriers and Access Charge Reform, *Fourth Report and Order in CC Docket No. 94-1 and Second Report and Order in CC Docket No. 96-262,* 12 FCC Rcd 16642 (1997) ("*Fourth Report and Order*"). I will refer to the annual adjustment in the price cap index as the "PCI adjustment factor."

[26] *Fourth Report and Order* at Appendix D.

[27] *Id.* at ¶ 139.

[28] The rationale for the selection of the X-Factor in the *Fourth Report and Order* was reversed and remanded by the United States Court of Appeals for the District of Columbia. *See USTA v. FCC*, 188 F.3d 521 (D.C. Cir. 1999) ("X-Factor Decision").

[29] *See* Price Cap Performance Review for Local Exchange Carriers and Access Charge Reform, CC Docket Nos. 94-1 and 96-262, *Further Notice of Proposed Rulemaking*, FCC 99-345 (rel. Nov. 15, 1999).

Gollop Study support GTE's position that a time series forecasting method more appropriately approximates what the next year's productivity offset would be under competition.

**DISCUSSION**

6. To mimic competition, the productivity offset should reflect expected future productivity gains. Forecasting does just this and in a way that both mimics how expectations are formed under competition and how prices move under competition. In addition, forecasting has an additional benefit—time series forecasting eliminates the debate over the appropriate number of years to include in the calculation of the productivity offset. Forecasting allows the data to reveal the appropriate weights to apply to its history.

7. More generally, forecasting most accurately reflects how markets "think" about prices. While firms in markets may not explicitly apply econometric techniques, nonetheless they still engage in implicit forecasting as part of the natural decision-making process. Specifically, firms predict how prices—both input and output—will behave in the future and plan their production and sales accordingly.

8. The above describes what happens in a competitive market, which is what the Commission is attempting to replicate in the price cap formula. In a competitive

[30] *See*, *e.g.*, GTE's Comments and Reply Comments, CC Docket No. 94-1, dated December 18, 1995, and March 1, 1996, respectively; Reply Comments of GTE, CC Docket Nos. 96-262, 94-1, 91-213, dated February 14, 1997.

market, output prices (*P*), input prices (W), and total factor productivity (*TFP*) are related by the equation

$$\frac{\dot{P}}{P} = \frac{\dot{W}}{W} - \frac{\dot{TFP}}{TFP} \qquad (1)$$

where all three terms are industry specific. In the multi-output/multi-input case, all three terms become indices—one for output price changes, one for input price changes, and one for total factor productivity changes—all measured in percent and all industry specific. This measurement method is called the direct method, which the Commission chose not to use in an attempt to avoid the possibility that the telecommunications industry might be able to manipulate an industry-specific price index. The Commission, instead, chose to replace the industry-specific measure of input price changes with a nationwide or U.S. input price index using the formula

$$\frac{\dot{P}}{P} = \frac{\dot{W}_{US}}{W_{US}} - \frac{\dot{TFP}}{TFP}. \qquad (2)$$

Since a direct estimate of the U.S. input price index does not exist, the Commission chose to back into one using a nationwide analog of (2) in the form of

$$\frac{\dot{P}_{US}}{P_{US}} = \frac{\dot{W}_{US}}{W_{US}} - \frac{\dot{TFP}_{US}}{TFP_{US}} \qquad (3)$$

and chose to measure $\frac{\dot{P}_{us}}{P_{us}}$ by $\frac{\dot{GDPPI}}{GDPPI}$ where, again, all the terms are to be interpreted as indices. Substituting equation (3) into equation (2) gives

$$\frac{\dot{P}}{P} = \frac{\dot{GDPPI}}{GDPPI} - \left[\frac{\dot{TFP}}{TFP} - \frac{\dot{TFP}_{us}}{TFP_{us}}\right] \tag{4}$$

which was the original "GDPPI minus X" form of the Commission's price cap formula adjustment methodology.

9. However, the Commission began to suspect the validity of the assumption that the industry input price index and the U.S. input price index measured the same thing so it added a term to the formula to account for such deviations

$$\frac{\dot{P}}{P} = \frac{\dot{GDPPI}}{GDPPI} - \left[\frac{\dot{TFP}}{TFP} - \frac{\dot{TFP}_{us}}{TFP_{us}}\right] + \left[\frac{\dot{W}^*}{W^*} - \frac{\dot{GDPPI}}{GDPPI}\right] \tag{5}$$

where $\frac{\dot{W}^*}{W^*}$ is a somewhat more reliable measure—at least from the Commission's point of view. This gives an X-Factor formula of

$$X = \left[\frac{\dot{TFP}}{TFP} - \frac{\dot{TFP}_{us}}{TFP_{us}}\right] + \left[\frac{\dot{W}^*}{W^*} - \frac{\dot{GDPPI}}{GDPPI}\right] \tag{6}$$

Properly done, this formula should reduce to

$$\frac{\dot{P}}{P} = \frac{\dot{W}^*}{W^*} - \frac{\dot{TFP}}{TFP}$$

which is the same formula given in equation (1) using a different input price index. However, the Commission did not choose to do this. Instead, it chose to use different indices for $\frac{\dot{GDPPI}}{GDPPI}$ in the two places it appears in equation (5).

The Commission did this by estimating the terms $\frac{\dot{GDPPI}}{GDPPI}$ and $X$ using different

and inconsistent methodologies. For the growth in *GDPPI*, it took a naive estimate, that is an estimate of the next period based on what ever happened today. For the *X* factor it used a moving average.

10. Without endorsing the formulation chosen by the Commission, my concern is how to use an historical series on GDPPI and X to estimate the price cap adjustment index, $\frac{P^{0}}{P}$, if indeed the Commission's assumptions are correct. A competitive firm in a competitive market would behave as if it chose its production for the next period by forecasting the next period's price and setting its output accordingly. By setting the change in the price cap index each year equal to the best available estimate of the change in competitive prices, the Commission will ensure that its price cap plan most effectively mimics a competitive market in terms of both incentives for the firms and the prices paid by consumers.

11. What estimate of next year's price would a competitive firm use? There are countless choices—many of which are naïve. Among these naïve estimates of next year's price are: (1) current period prices, (2) current prices plus this period's price change, and (3) a moving average of past price changes. All of these are arbitrary and subject to manipulation as noted in the X-Factor Decision. In its 1997 Order, the Commission chose to use, for each annual filing, the most recent year's estimate of the change in GDPPI from the Bureau of Labor Statistics ("BLS"). It chose to fix the X-Factor based on a selection of five-year averages, arbitrarily chosen from the data available at the time.

12. This arbitrariness is unnecessary as there exist, and have existed for nearly forty years, accurate and automatic methods for forecasting. Because these methods produce the most efficient estimates, competitive firms will behave as if they forecast prices using these optimal forecasting techniques. Thus, a regulatory agency trying to mimic the role of the market should produce its estimate in the same manner as a firm in the market would produce one.

13. What are these optimal forecasting techniques? The basic framework widely accepted today by economists and statisticians for time-series forecasting is the Box-Jenkins approach.[31] Without dwelling on the finite details of the Box-Jenkins approach, there are four basic steps through which a statistician would determine the optimal model to be used for forecasting. The first step is identification—determining what kind of time series the data comprise. The second is transformation—transforming the data to stationarity,[32] if necessary. The third is estimation—estimating the unknowns in the specification of the time series. The fourth step is forecasting—given the results of the first three steps, a forecast can be produced that predicts the next period's price change and it can be done optimally. The Commission has ignored the first three steps of the process—particularly that of identification—and jumped immediately to forecasting where it applies, in effect, a one-year a moving average

[31] George E. P. Box, Gwilym M. Jenkins, and Gregory C. Reinsel, *Time Series Analysis: Forecasting and Control* (Prentice-Hall: 1994) Third Edition.

[32] If there is a trend in the data, one would subtract this trend from the data before proceeding to do further analysis. Often a series is not stationary, but the percent differences of the series are stationary. In this case, one would convert the data to percent differences before proceeding.

methodology to $\frac{GDPPI^{\&}}{GDPPI}$ and an arbitrary choice of five-year averages to X to estimate $\frac{P^{\&}}{P}$, the price cap adjustment index.

14. There are two reasons this approach is problematical. First, moving averages can be biased. That is, price change estimates systematically will either over estimate or under estimate the true price change. Moving averages have a tendency to overfit the data, giving low error estimates in sample, but poor performance out of sample. Second, even when unbiased, they can be too sensitive to random error. The technical term for this second condition is inefficiency. In part, this arises from ignoring relevant information. In fact, where optimal forecasting processes improve in accuracy as more information becomes available, the accuracy of fixed moving averages remains the same. What causes bias and inefficiency is choosing a forecasting technique that is inconsistent or not optimal given the identification of the type of time series the data form. By correctly identifying the type of series, an optimal forecasting method can be selected. Since both the identification process and the forecasting process can be readily automated; *i.e.*, off-the-shelf software exists to remove the need for judgement (or almost all judgement) on the part of the forecaster, the arbitrary nature of the Commission's methodology can be totally eliminated. Similarly, any possibility of manipulation can be removed.

15. Forecasting methods without pre-established and scientifically founded rules will negatively affect the regulatory process. Subjective decision-making allows for continuous debate regarding both summary statistics and the treatment of

anomalous data points. Procedures founded upon econometric theory follow rules with a long history of support. A well-established set of rules also allows the interested parties to anticipate future changes because the "rules of the game" cannot suddenly change. Adequate anticipation of future economic conditions is crucial for a success in business and for competitively efficient market outcomes.

16. GTE's proposal is simple. Each period (a year given the available data), a formal time series analysis of all previous relevant data should be conducted and the time series identified. Given that identification, an optimal forecast of $\frac{P^{\&}}{P}$ for the next year should be used as the price cap adjustment factor. The need for yearly updates is threefold. First, it improves efficiency. At any given point, the Commission need only estimate one year ahead. New information is incorporated as it becomes available, and there is no need for the Commission to speculate about possible changes in future productivity. Second, it allows detection of structural changes that might indicate the need to change the forecasting methodology—albeit likely only slightly. Again, it is important to point out that the change in forecasting technique is automatic and transparent to the user as software packages, such as SAS, take care of all of the changes. Further, anyone with a background or even an understanding of economics, math, computer science, or statistics should be able with a minimum amount of training be able to perform the required analysis in less than an hour. The statistical analysis itself—the forecast—should take only seconds. Third, because the process is continuous and automatic, there is no need for repeated

reviews of the price cap methodology or for sudden, discontinuous changes in the price cap index.

17. In this *Further Notice of Proposed Rulemaking*, the Commission seeks comment on how it should choose the X-Factor given estimates of productivity changes in past periods. The time series method I propose here would be the most accurate and statistically valid method for deriving an estimate of the X-Factor. However, I propose that the Commission should instead estimate the PCI adjustment factor itself, based on historical data on both productivity and inflation. This combined approach would treat the estimation of both components of the PCI adjustment factor in a consistent manner, which the Commission has not done in the past. It would allow data on GDPPI changes for all prior years in the sample to be considered. Finally, the combined series of PCI adjustment factors is more stable than either GDPPI or the X-Factor taken separately because the growth in GDPPI and the X factor are highly correlated, 0.67 to be exact. Thus, the errors in each series tend to cancel each other out. Because the PCI adjustment for the next period is the desired result of the Commission's calculation, it is more efficient to estimate that number directly, rather than to estimate its components separately.[33]

## ANALYSIS

18. For the purposes of this study, I analyzed two series of data. The first series consisted of the productivity offsets or X-Factors. The second series used the

[33] Note that when data are available with more than a year's lag, then the one-year ahead forecast is modified to a two or more year ahead forecast.

Commission's differential method for calculating the overall Price Cap Index ("PCI") adjustment factor. The Commission uses the formula:

$$\%\Delta P_{LEC} = \%\Delta GDPPI - X +/- Z$$

where $\%\Delta P_{LEC}$ is the PCI adjustment factor, $\%\Delta GDPPI$ is the Gross Domestic Producer Price Index, X is the productivity offset, and Z represents exogenous cost changes.[34] The observed productivity offset and observed PCI adjustment factor are found in Table 1.

**Table 1**
**Observed Productivity Offset and Price Cap Adjustment Factor**

| Year | Productivity Offset | Price Cap Adjustment Factor |
|---|---|---|
| 1986 | -1.13% | 3.29% |
| 1987 | 6.36% | -3.53% |
| 1988 | 6.42% | -3.11% |
| 1989 | 6.52% | -2.74% |
| 1990 | 8.99% | -5.14% |
| 1991 | 6.06% | -2.75% |
| 1992 | 3.08% | -0.94% |
| 1993 | 3.51% | -0.85% |
| 1994 | 5.47% | -3.40% |
| 1995 | 6.20% | -4.09% |
| 1996 | 1.98% | -0.15% |
| 1997 | 3.62% | -1.97% |
| 1998 | 3.03% | -1.86% |

I performed the time-series analysis on the productivity offset and on the overall price cap adjustment factor.

19. I analyzed the productivity offset and PCI adjustment factor by using Autoregressive Integrated Moving Average ("ARIMA") time series methods. To

[34] For the purposes of this study, exogenous changes are assumed to be zero.

do this, I undertook the four steps discussed above, based on well-accepted rules governing each step. First, I investigated the each data series to see if trends or unit roots existed, that is I looked for stationarity. If a trend had been found within the data series, the data would have been differenced until the trend was removed. If some other form of non-stationarity were found, the data would be transformed so that stationarity was achieved. Such transformations were unnecessary as each data series under examination appeared stationary. This ruled out the presence of a trend within the data. Examining the standard stationary case, I assumed that:

$$y_t - \mu = \sum_{i=1}^{p} \alpha_i (y_{t-i} - \mu) + \sum_{j=0}^{q} \theta_j \varepsilon_{t-j}$$

where the $\xi$ are white noise errors. The parameters *p* and *q*, representing the number of lags in the autoregressive part and in the moving average parts, respectively, are the values determined in the identification phase of the ARIMA process.[35] The identification phase is completed by examining the direct, inverse, and partial autocorrelation functions, and by comparing the Akaike Information Criterion ("AIC") values.

20. For both the productivity offset and the PCI adjustment factor, the specification portion of the ARIMA process yielded an ARMA(0,0), the form of which may be found by setting *p*=0 and *q*=0 in the standard equation. This bases the equation on the $\mu$ (the mean) and the error term. Other possible specifications

were eliminated based on the AIC. Finally, small sample parametric and non-parametric independence tests eliminated the possibility of some other form of dependence.

21. As an additional test of forecasting methods, the predictive power of the econometric method (ARMA (0,0)), and of three, five, and seven year averages, was tested for both the productivity offset and the PCI adjustment factor. The forecasted values were then compared to the values observed in the corresponding year. A graph of the predictive power of each model shows that no model was able to replicate exactly the observed productivity offsets or PCI adjustment factors.

**Figure 1**
**Observed and Predicted Productivity Offset**

[35] Time series are referred to by their structure. Many time series are found to be ARIMAs. Simply, this means that these processes are easily forecast based on their own past values. Such processes are called self-predicting.

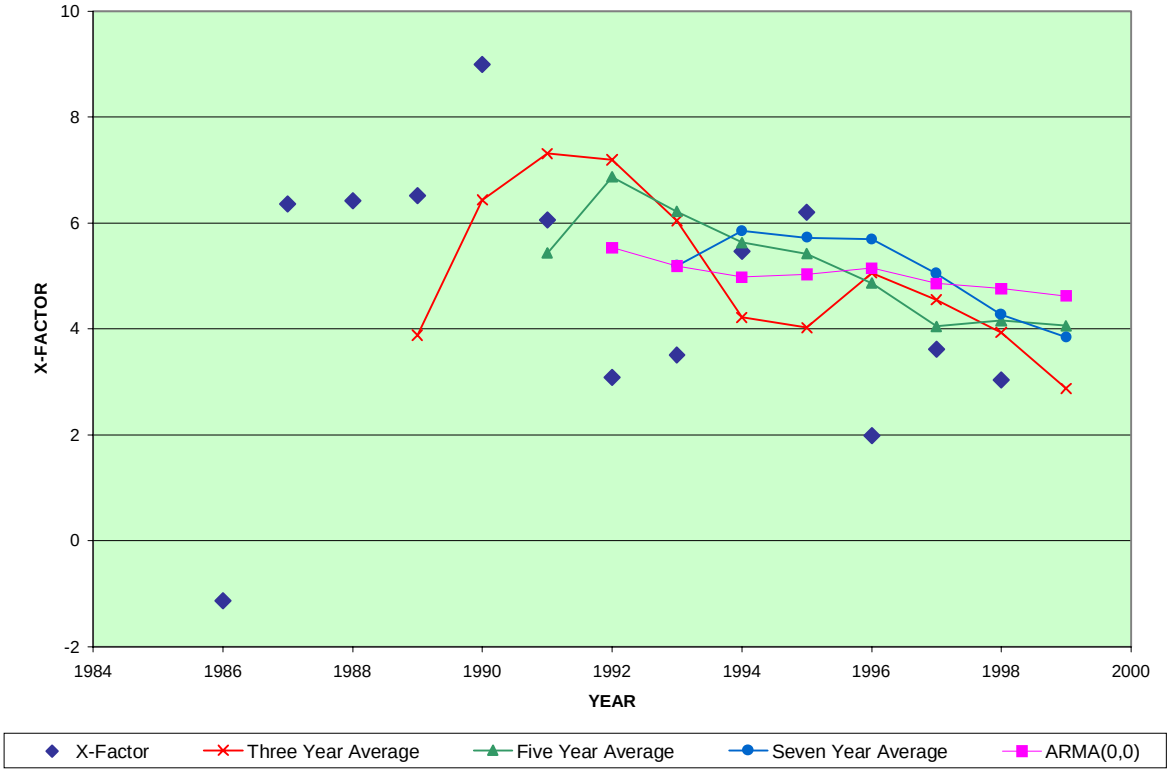
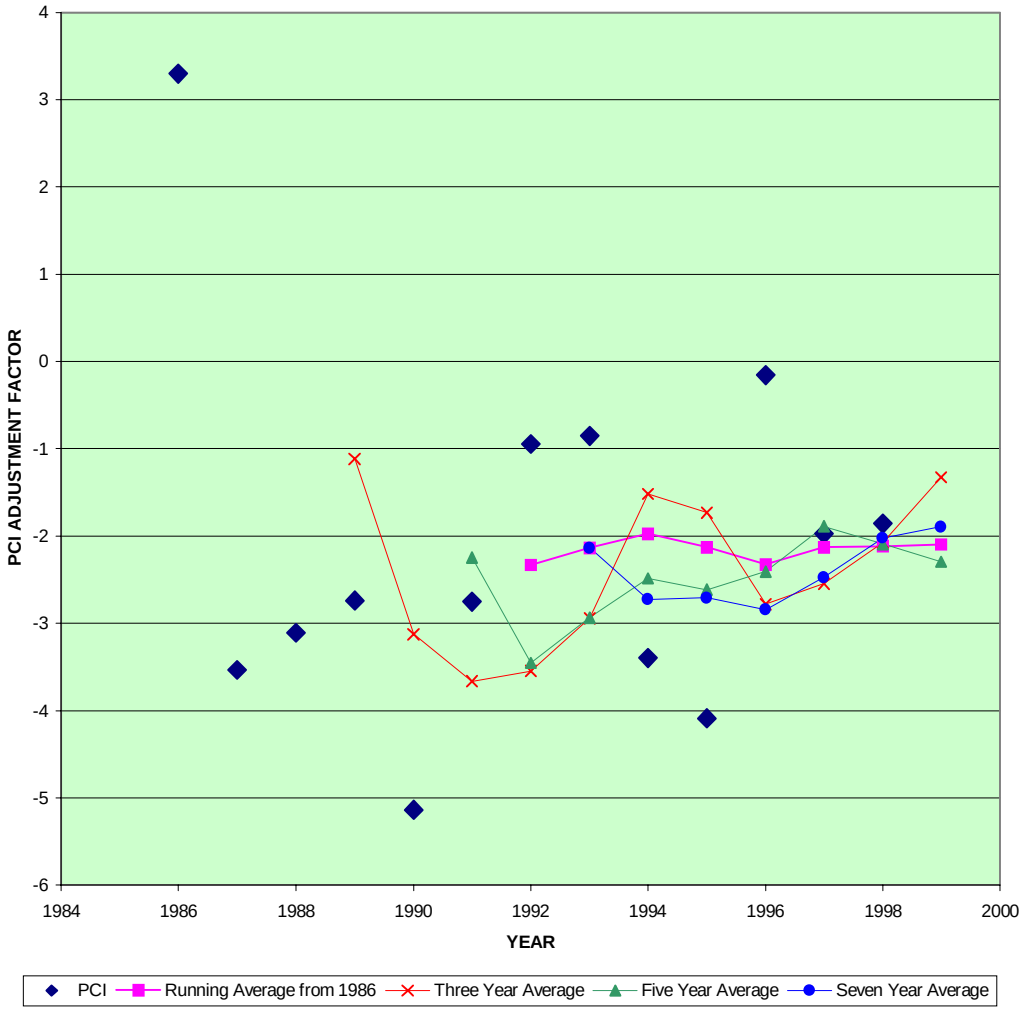

10
8
6
4
2
0
-2
X-FACTOR
1984
1986
1988
1990
1992
1994
1996
1998
2000
YEAR
X-Factor
Three Year Average
Five Year Average
Seven Year Average
ARMA(0,0)

**Figure 2**
**Observed and Predicted PCI Adjustment Factor**




22. Since no method of calculation perfectly predicts the observed price cap adjustment, I performed a second test, an examination of the sum of squared deviations from observed values, calculated by the formula:

$$\sum_{i=j}^{N} (observed_i - fitted_i)^2$$

where *j* is the first year of data for observed and predicted values. The total deviation from the observed values for the time period 1993 to 1998 is found in Table 3.

**Table 3**
**Sum of Squared Deviations from Observed Values**

| FORMULA | ARMA(0,0) | 3 Year Average | 5 Year Average | 7 Year Average |
|---|---|---|---|---|
| Productivity Offset | 18.97 | 21.51 | 23.91 | 17.71 |
| PCI Adjustment | 8.65 | 12.84 | 7.31 | 9.44 |

23. For the period from 1993 to 1998, using a five-year average provides the best prediction overall, by minimizing the deviation from the observed values. The use of the time series process, ARMA(0,0) comes in a close second in minimizing deviation. Averages of three and seven years do not come as close to accurate predictions. Despite the slightly better performance of the five-year average in predicting 1993 to 1998 values, the time series forecast remains the superior option for prediction. While a five-year average was the best predictor in this time period, an alternative number of included observations might prove the better predictor in a different time period. The use of the time series analysis removes the question about the number of years to include in the study and maintains similar predictive power to the best available simple average.

24. Using the data available through 1998 from the Gollop Study, the productivity offset, or X-Factor, and the PCI adjustment factor for 1999 were calculated using the model identified by the ARIMA process and by simple three, five, and seven year averages. Table 4 shows the results from each of several

forecasting techniques, including the recommended productivity offset of 4.6 percent.

**Table 4**
**A Comparison of the Estimated Productivity Offset and the PCI Adjustment Factor**

| FORMULA | ARMA(0,0) | 3 Year Average | 5 Year Average | 7 Year Average |
|---|---|---|---|---|
| Productivity Offset | **4.62%** | 2.88% | 4.06% | 3.84% |
| PCI Adjustment | **-2.09%** | -1.33% | -2.29% | -1.90% |

25. As the specification of the chosen ARIMA process depends upon tendencies within the data under examination, the ARIMA identification process should be undertaken each year. This simple procedure can be done using one of several commercially available software packages. While forecasting is not as easy as calculating an average, the ARIMA process does provide better predictive power and allows the inclusion of all data. Moreover, as has been the case heretofore, when a simple average is called for the ARIMA methodology identifies that and uses it.

26. Therefore, I recommend that the Commission seriously consider using optimal time series forecasting methods, instead of arbitrary moving average methods, as they are better suited to predicting both the next year's productivity or X-Factor and the PCI adjustment that would be found under competition.

## COMMENTS ON THE FRIEDLANDER STUDY

27. Friedlander derives a historical revenue method from the Commission's TFP-based method using combined interstate and intrastate measures. He then

claims that the result holds by analogy for interstate only measures and, consequently, claims to have discovered an interstate only TFP-based X-factor. He has not.

28. Friedlander derives an X-Factor formula based on LEC revenues and other terms. His resulting equation (8) does not contain an explicit cost term; therefore, he incorrectly assumes that he has avoided the need to separate costs into interstate and intrastate components. That is, he assumes that no allocation was needed. This is wrong. To see this, one can work the algebra backward from Friedlander's equation (8) by simply replacing INTERSTATE everywhere he has LEC in his derivation. When this is done, we find that page 3 of Appendix A needs be amended to read:

> "$X = \%\Delta Q_{INTERSTATE} - \left(\%\Delta N_{INTERSTATE} - \%\Delta IP_{INTERSTATE}\right) - \%\Delta TFP_{US} - \%\Delta IP_{US}$
>
> The term in parentheses ($\%\Delta N_{INTERSTATE} - \%\Delta IP_{INTERSTATE}$) represents the growth in INTERSTATE input costs or growth in factor payments. In the Commission's 1997 TFP study, *this term is exactly equal to the growth in INTERSTATE total revenues*."

29. It is at this point that Friedlander slips in the erroneous separation assumption. He assumes a separate and economically meaningful interstate cost or factor payment index exists. As Friedlander himself admits, no such index exists nor can it be made to exist (*see* Appendix A, p. 2, ¶ 2). As this Commission has recognized,[36] no such index does exist or can exist. Therefore, without such an allocation or separation, the algebra when worked forward is incorrect as well.

[36] *See, e.g.*, *Fourth Report and Order* at ¶ 110.

30. A TFP-based price cap formula cannot be based on the equality of interstate revenues and allocated intrastate costs unless the cost structure is separable between interstate and intrastate activities. Roughly speaking, this requires no joint, common, or shared costs between interstate and intrastate services. It is well known to this Commission that shared costs do exist and are substantial. The Commission's long running rejection of the notion of an interstate only TFP-based price cap index derives from its clear understanding of this point.

31. Thus, because the Friedlander method requires the assumption that interstate and intrastate costs can be separated in an economically meaningful way and because it is well known that costs cannot be so separated, the Friedlander method must be rejected out of hand.

## CONCLUSION

32. The unambiguously correct way to forecast the price cap adjustment factor or the X-Factor and thus to mimic the dynamics of a competitive market is to use an optimal forecasting method. In this case, the average of all previous data was found to be optimal. As the mean is an ARMA(0,0) this suggests that on a going-forward basis analysis can be restricted to identification, estimation, and forecasting of an ARMA(p,q) series, where p and q can be automatically determined using the Box-Jenkins methodology as directed in PROC ARIMA in the SAS/ETS statistical programming module. For now, however, a simple mean of all previous data is best and dominates in all ways the methodology previously employed by the Commission.

33. Finally, Mr. Friedlander's claim that he has developed an economically meaningful interstate only X-Factor is erroneous. His method should be rejected.

I hereby swear that the foregoing is true and correct.

_____

Gregory M. Duncan

Subscribed and sworn to before me this ____ day of January 2000.

_____

Notary Public

My Commission expires: _____

## CERTIFICATE OF SERVICE

I, Judy R. Quinlan, hereby certify that copies of the foregoing "GTE Reply Comments" have been mailed by first class United States mail, postage prepaid, on January 24, 2000 to the parties on the enclosed list.

_____
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